

# Abbas Askar

Bartycka 18, Nicolaus Copernicus Astronomical Center, 00-716 Warsaw, Poland

✉ askar@camk.edu.pl or ✉ abbas.askar@gmail.com • 🌐 www.abbasaskar.com

in abbas-askar-8542141/ • 🐦 AbbasAskar • 🌐 abs2k12

Date of Birth: 1987-08-31, ORCID: [0000-0001-9688-3458](https://orcid.org/0000-0001-9688-3458), [CAMK Webpage](#)

## Professional Appointments & Experience

<b>Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences</b> <i>Assistant Professor (Adiunkt)</i> POLONEZ and Marie Skłodowska-Curie Fellow	<b>Warsaw (Poland)</b>  Sep 2023–Present
<b>Lund Observatory (from 2023: Division of Astrophysics, Department of Physics) Lund University (Sweden)</b> <i>Postdoctoral Researcher</i>	<b>Lund University (Sweden)</b> June 2020–Aug 2023
<b>Lund Observatory, Department of Astronomy and Theoretical Physics</b> <i>Carl Trygger Postdoctoral Fellow (2018–2020)</i>	<b>Lund University (Sweden)</b> June 2018–May 2020
<b>Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences</b> <i>Graduate Student/Research Assistant</i>	<b>Warsaw (Poland)</b> Nov 2013–May 2018

## Education

<b>Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences, Warsaw (Poland)</b> • <b>PhD in Astronomy (with distinction)</b> Thesis: "Investigation of Black Hole Populations in Dense Stellar Systems using <a href="#">MOCCA code</a> for Star Cluster Simulations" Supervisor: Prof Mirek Giersz	<b>Nov 2013–May 2018</b>
<b>University of Innsbruck (Austria), University of Padova (Italy) &amp; University of Belgrade (Serbia)</b> • <b>Master of Science in Astronomy &amp; Astrophysics</b> Astromundus: Erasmus Mundus Joint Masters Degree Master Thesis: "Optical Counterparts of Ultraluminous X-ray Sources" Supervisor: Dr Luca Zampieri (INAF - Padova)	<b>Oct 2010–Sep 2012</b>
<b>University College Utrecht, Utrecht University (The Netherlands)</b> • <b>Bachelor of Science (Hons) and Bachelor of Arts (Hons) in Liberal Arts &amp; Sciences</b> Double Major in Physical Sciences (Physics & Mathematics) and Humanities (Philosophy & Religious Studies) Bachelor Thesis (Science): "Peculiar Features in the Onsets of Thermonuclear Flashes on Neutron Stars" Supervisor: Dr. Jean in't Zand (HEA, SRON Netherlands Institute for Space Research) Bachelor Thesis (Humanities): "The Problem of Redemptive Truth: From Nietzsche to a Post-Metaphysical Culture" Supervisor: Dr. Floris van der Burg (University College Utrecht, Utrecht University)	<b>Aug 2006–July 2009</b>

## Publications in peer-reviewed scientific journals

A complete list of all publications can be found at the [NASA ADS service](#) or [ORCID Page](#) or [Google Scholar Page](#)

1. A. R Livernois; F I Aros, E Vesperini, **A Askar**, A Bellini, M Giersz, J Hong, A Hypki, M Libralato, and T Ziliotto: *Energy equipartition in multiple-population globular clusters MNRAS*, Vol. 534, Issue 3, pp.2397-2409 (2024) [\[ADS Link\]](#)
2. L. Hellström, M. Giersz, A Hypki, D. Belloni, **A. Askar**, and G. Wiktorowicz : *Double white dwarf binary population in MOCCA star clusters: Comparisons with observations of close and wide binaries Astronomy & Astrophysics* Vol. 690, id.A112, 13 pp. (2024). [\[ADS Link\]](#)
3. A. Hypki, E. Vesperini, M. Giersz, J. Hong, **A. Askar**, M. Otulakowska-Hypka, L. Hellstrom, G. Wiktorowicz: *Accepted for publication in Astronomy & Astrophysics* (2024). [\[ADS Link\]](#)
4. B. Bhat, B. Lanzoni, E. Vesperini, F. R. Ferraro, F. I. Aros, **A. Askar**, and A. Hypki: *New Parameters for Star Cluster Dynamics: The Role of Clusters' Initial Conditions ApJ*, Vol. 968, Issue 1, id.2, 11 pp (2024). [\[ADS Link\]](#)
5. **A. Askar**, V.F. Baldassare and M. Mezcuca: *Intermediate-Mass Black Holes in Star Clusters and Dwarf Galaxies* Chapter 2 in the book, "Black Holes in the Era of Gravitational Wave Astronomy", ed. Arca Sedda, Bortolas, Spera, pub. Elsevier. (June 2024) DOI: 10.1016/b978-0-32-395636-9.00010-4, Part of ISBN: 9780323956369 [\[ADS Link\]](#)
6. M. Pasquato, P. Trevisan, **A. Askar**, P. Lemos, G. Carenini, M. Mapelli and Y. Hezaveh: *Interpretable machine learning for finding intermediate-mass black holes ApJ*, Vol. 965, Issue 1, id.89, 15 pp (2024). [\[ADS Link\]](#)

7. P. Amaro-Seoane, J. Andrews, M. Arca Sedda, **A. Askar** and 154 co-authors: *Astrophysics with the Laser Interferometer Space Antenna. Living Reviews in Relativity*, Volume 26, Issue 1, article id.2 (2023). [\[ADS Link\]](#)
8. A. Leveque, M. Giersz, **A. Askar** and M. Arca-Sedda: *MOCCA-Survey Database: Extra Galactic Globular Clusters. III. The population of black holes in Milky Way and Andromeda - like galaxies MNRAS*, Vol. 514, Issue 4, pp.5751-5766 (2023) [\[ADS Link\]](#)
9. L. Hellström **A. Askar**, A. Trani, M. Giersz, R. Church and J. Samsing: *Influence of tidal dissipation on outcomes of binary-single encounters between stars and black holes in stellar clusters. MNRAS*, Vol. 517, Issue 2, pp.1695-1708 (2022). [\[ADS Link\]](#)
10. A. Hypki, M. Giersz, J. Hong, A. Leveque, **A. Askar**, D. Belloni and M. Otulakowska-Hypka: *MOCCA: Dynamics and evolution of binary stars of multiple stellar populations in tidally filling and underfilling globular star clusters. MNRAS*, Vol. 517, Issue 4, pp.4768-4787 (2022). [\[ADS Link\]](#)
11. N. Singh, T. Bulik, K. Belczynski and **A. Askar**: *Exploring compact binary populations with the Einstein Telescope. Astronomy & Astrophysics* Vol. 667, id.A2, 15 pp. (2022). [\[ADS Link\]](#)
12. K. Maliszewski, M. Giersz, Mirek, D. Gondek-Rosińska, **A. Askar** and A. Hypki: *MOCCA-SURVEY Database II – Properties of Intermediate Mass Black Holes escaping from star clusters. MNRAS*, Vol. 514, Issue 4, pp.5879-5889 (2022). [\[ADS Link\]](#)
13. A. Leveque, M. Giersz, M. Arca-Sedda, **A. Askar**: *MOCCA-survey data base: extra galactic globular clusters - II. Milky Way and Andromeda. MNRAS*, Vol. 514, Issue 4, pp.5751-5766 (2022). [\[ADS Link\]](#)
14. **A. Askar**, M. B. Davies and R. P. Church: *Formation of supermassive black holes in galactic nuclei II: retention and growth of seed intermediate-mass black holes. MNRAS*, Vol. 511, Issue 2, pp.2631-2647 (2022). [\[ADS Link\]](#)
15. A. Kamlah, A. Leveque, R. Spurzem, M. Arca Sedda, **A. Askar**, S. Banerjee, P. Berczik, M. Giersz, J. Hurley, D. Belloni, L. Kühmichel and L. Wang: *Preparing the next gravitational million-body simulations: Evolution of single and binary stars in Nbody6++GPU, MOCCA and McLuster MNRAS*, Vol. 511, Issue 3, pp.4060-4089 (2022). [\[ADS Link\]](#)
16. F. Aros, A. C. Sippel, A. Mastrobuono-Battisti, P. Bianchini, **A. Askar** and G. van de Ven: *Using Binaries in Globular Clusters to Catch Sight of Intermediate-Mass Black Holes. MNRAS*, Vol. 508, Issue 3, pp.4385-4398 (2021). [\[ADS Link\]](#)
17. **A. Askar**, M. B. Davies and R. P. Church: *Formation of super-massive black holes in galactic nuclei I: delivering seed intermediate-mass black holes in massive stellar clusters. MNRAS*, Vol. 502, Issue 2, pp.2682-2700 (2021). [\[ADS Link\]](#)
18. F. Aros, A. C. Sippel, A. Mastrobuono-Battisti, **A. Askar**, P. Bianchini and G. van de Ven: *Dynamical modelling of globular clusters: challenges for the robust determination of IMBH candidates. MNRAS*, Vol. 499, Issue 4, pp.4646-4665 (2020). [\[ADS Link\]](#)
19. J. Hong, **A. Askar**, M. Giersz, A. Hypki and S. Yoon: *MOCCA-SURVEY Database I: Binary black hole mergers from globular clusters with intermediate mass black holes. MNRAS*, Vol. 498, Issue 3, pp.4287-4294 (2020). [\[ADS Link\]](#)
20. J. Samsing, D. J D'Orazio, K. Kremer, C. L. Rodriguez and **A. Askar**: *Single-single gravitational-wave captures in globular clusters: Eccentric deci-Hertz sources observable by DECIGO and Tian-Qin. Physical Review D*, Vol. 101, Issue 12, article id.123010 (2020). [\[ADS Link\]](#)
21. K. Belczynski, J. Klencki, C. E. Fields, A. Olejak, E. Berti, G. Meynet, C. L Fryer, D. Holz, R. O'Shaughnessy, D. A. Brown, T. Bulik, S. Leung, K. Nomoto, P. Madau, R. Hirschi, S. Jones, S. Mondal, M. Chruslinska, P. Drozda, D. Gerosa, Z. Doctor, M. Giersz, S. Ekstrom, C. Georgy, **A. Askar**, V. Baibhav, D. Wysocki, T. Natan, W. M. Farr, G. Wiktorowicz, Miller, M. Coleman, B. Farr and J.P Lasota: *The evolutionary roads leading to low effective spins, high black hole masses, and O1/O2 rates of LIGO/Virgo binary black holes. A&A*, Vol. 636, id.A104, 40 pp. (2020). [\[ADS Link\]](#)
22. B. Giesers, S. Kamann, S. Dreizler, T. Husser, **A. Askar**, F. Göttgens, J. Brinchmann, M. Latour, P. M. Weilbacher, M. Wendt and M. M. Roth: *A stellar census in globular clusters with MUSE: Binaries in NGC 3201. A&A*, Vol. 632, id.A3, 20 pp. (2019). [\[ADS Link\]](#)
23. M. Giersz, **A. Askar**, L. Wang, A. Hypki, A. Leveque and R. Spurzem: *MOCCA-SURVEY database I. Dissolution of tidally filling star – clusters harbouring black hole subsystems. MNRAS*, Vol. 487, Issue 2, p.2412-2423 (2019). [\[ADS Link\]](#)
24. A. Askar, **A. Askar**, M. Pasquato and M. Giersz,: *Finding Black Holes with Black Boxes Using Machine Learning to Identify Globular Clusters with Black Hole Subsystems. MNRAS*, Vol. 485, Issue 4, p.5345-5362 (2019). [\[ADS Link\]](#) and [\[Github Page\]](#)

25. B. Leor, V. Cardoso, S. Nissanke, T. P. Sotiriou, **A. Askar**, K. Belczynski, G. Bertone, E. Bon and 194 coauthors. *Black holes, gravitational waves and fundamental physics: a roadmap Classical and Quantum Gravity* Vol. 36, 14, article id. 143001 (2019). [\[ADS Link\]](#). Contributor for chapter I.5 in this **review paper**.
26. D. Belloni, M. Giersz, L.E. Rivera Sandoval, **A. Askar** and P. Ciecielag: *MOCCA-SURVEY database I. Accreting white dwarf binary systems in globular clusters – IV. cataclysmic variables – properties of bright and faint populations*. *MNRAS*, Vol. 483, Issue 1, p.315-331 (2019). [\[ADS Link\]](#)
27. J. Morawski, M. Giersz, **A. Askar**, and K. Belczynski: *MOCCA-SURVEY Database I: Assessing GW kick retention fractions for BH-BH mergers in globular clusters*. *MNRAS*, Vol. 481, Issue 2, p.2168-2179 (2018). [\[ADS Link\]](#)
28. J. Hong, E. Vesperini, **A. Askar**, M. Giersz, and M. Szkudlarek: *Binary Black Hole Mergers from Globular Clusters: the Impact of Globular Cluster Properties..* *MNRAS* Vol. 480, Issue 4, p.5645-5656 (2018). [\[ADS Link\]](#)
29. M. Arca-Sedda, **A. Askar**, and M. Giersz: *MOCCA-SURVEY Database I. Unravelling black hole subsystems in globular clusters*. *MNRAS* Vol. 479, Issue 4, p.4652-4664 (2018). [\[ADS Link\]](#)
30. **A. Askar**, M. Arca-Sedda, and M. Giersz: *MOCCA-SURVEY Database I: Galactic Globular Clusters Harboursing a Black Hole Subsystem*. *MNRAS* Vol. 478, Issue 2, p.1844-1854 (2018). [\[ADS Link\]](#)
31. K. Belczynski, **A. Askar**, M. Arca-Sedda, M. Chruslinska, M. Donnari, M. Giersz, M. Benacquista, R. Spurzem, D. Jin, G. Wiktorowicz and D. Belloni: *The origin of the first neutron star – neutron star merger*. *A&A*, Vol. 615, id.A91, 13 pp (2018). [\[ADS Link\]](#)
32. **A. Askar**, M. Giersz, W. Pych and E. Dalessandro: *COCOA code for creating mock observations of star cluster models*. *MNRAS* Vol 475, Issue 3, p.4170-4185 (2017). [\[ADS Link\]](#) and [\[Github Page\]](#)
33. J. Samsing, **A. Askar** and M. Giersz: *MOCCA-SURVEY Database I: Eccentric Black Hole Mergers During Binary-Single Interactions In Globular Clusters*. *ApJ* Vol. 855, 2, article id. 124, 5 pp.(2018). [\[ADS Link\]](#)
34. J. Hong, R. de Grijs , **A. Askar**, P. Berczik, C. Li, L. Wang, L. Deng, M. B. N. Kouwenhoven, M. Giersz and M., R. Spurzem: *The dynamical origin of multiple populations in intermediate-age clusters in the Magellanic clouds*. *MNRAS* Vol 472, 1, p.67-77(2017). [\[ADS Link\]](#)
35. D. Belloni, **A. Askar**, M. Giersz, P. Kroupa & H.J. Rocha-Pinto: *On the initial binary population for star cluster simulations*. *MNRAS* Vol 471, 3, p.2812-2828 (2017). [\[ADS Link\]](#)
36. D. Belloni, M. Zorotvic, M. Schreiber, N.W.C Leigh, M. Giersz and **A. Askar**: *MOCCA-SURVEY database I. Accreting white dwarf binary systems in globular clusters – III. Cataclysmic variables – Implications of model assumptions*. *MNRAS* 2017 Vol. 468, 2, p.2429-2446 (2017). [\[ADS Link\]](#)
37. R.d. Vita, M. Trenti, P. Bianchini, **A. Askar**, M. Giersz and G. van de Ven: *Prospects for detection of intermediate-mass black holes in globular clusters using integrated-light spectroscopy*. *MNRAS* Vol. 467, 4, p.4057-4066 (2017). [\[ADS Link\]](#)
38. D. Belloni, M. Giersz, H.J. Rocha-Pinto, N.W.C Leigh, **A. Askar**: *MOCCA-SURVEY database I. Accreting white dwarf binary systems in globular clusters - II. Cataclysmic variables - progenitors and population at birth*. *MNRAS* Vol 464, 4, p.4077-4095 (2017). [\[ADS Link\]](#)
39. **A. Askar**, M. Szkudlarek, D. Gondek-Rosińska, M. Giersz and T. Bulik: *MOCCA-SURVEY Database - I. Coalescing binary black holes originating from globular clusters*. *MNRAS Letters* Vol. 464, p.L36-L40 (2017). [\[ADS Link\]](#)
40. **A. Askar**, P. Bianchini, R.d. Vita, M. Giersz, A. Hypki and S. Kamann: *MOCCA-SURVEY Database I: Is NGC 6535 a dark star cluster harbouring an IMBH?* *MNRAS* Vol 464,3, p.3090-3100 (2017). [\[ADS Link\]](#)
41. D. Belloni, M. Giersz, **A. Askar**, N.W.C Leigh and A. Hypki: *MOCCA-SURVEY database I. Accreting white dwarf binary systems in globular clusters - I. Cataclysmic variables - present-day population*. *MNRAS* Vol. 462, 3, p.2950-2969 (2016). [\[ADS Link\]](#)
42. L. Wang, R. Spurzem, S. Aarseth, M. Giersz, **A. Askar**, P. Berczik, T. Naab, R. Shadow and M. B. N. Kouwenhoven: *The DRAGON simulations: globular cluster evolution with a million stars*. *MNRAS* Vol. 458, 2, p.1450-1465 (2016). [\[ADS Link\]](#)
43. M. Giersz, N. Leigh, A. Hypki, N. Lützgendorf and **A. Askar**: *MOCCA code for star cluster simulations - IV. A new scenario for intermediate mass black hole formation in globular clusters*. *MNRAS* Vol. 454, 3, p.3150-3165 (2015). [\[ADS Link\]](#)

## Submitted Papers & Preprints

1. Li E.-K., Liu S., Torres-Orjuela A., Chen X., Inayoshi K., Wang L., Hu Y.-M., Amaro-Seoane P., **Askar A.**, Bambi C., and 43 co-authors *Gravitational Wave Astronomy With TianQin* (2024). [\[ADS Link\]](#)

2. M. Arca-Sedda, **A. Askar**, and M. Giersz: *MOCCA-SURVEY Database I. Intermediate mass black holes in Milky Way globular clusters and their connection to supermassive black holes* (2019). [\[ADS Link\]](#)
3. J. Samsing, D. J D'Orazio, **A. Askar** and M. Giersz: *Black Hole Mergers from Globular Clusters Observable by LISA and LIGO: Results from post-Newtonian Binary-Single Scatterings* (2018). [\[ADS Link\]](#)

## Published conference proceedings

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1. M. B. Davies, **A. Askar**, R.P. Church: *The Ecology of the Galactic Centre: Nuclear Stellar Clusters and Supermassive Black Holes*, IAU Symposium, Volume 315 (2020). [\[ADS Link\]](#)
2. **A. Askar**, M. Giersz, , M. Arca Sedda, A. Askar, M. Pasquato, A. Leveque *Stellar-Mass Black Holes in Globular Clusters: Dynamical Consequences and Observational Signatures*, IAU Symposium, Volume 315 (2020). [\[ADS Link\]](#)
3. D. Belloni, M. Giersz, L.E. Rivera Sandoval, **A. Askar**, P. Ciecielag: *Are most Cataclysmic Variables in Globular Clusters dynamically formed?*, IAU Symposium, Volume 315 (2020). [\[ADS Link\]](#)
4. M. Giersz, **A. Askar**, L. Wang, A. Hypki, A. Leveque, R. Spurzem: *MOCCA-SURVEY database I. Dissolution of tidally filling star – clusters harbouring black hole subsystems*, IAU Symposium, Volume 315 (2020). [\[ADS Link\]](#)
5. A. Hypki, M. Giersz, **A. Askar**, D. Belloni, A. Leveque: *BEANS – distributed data analysis for numerical simulations*, IAU Symposium, Volume 315 (2020). [\[ADS Link\]](#)
6. M. Giersz, **A. Askar**, J. Klencki, J. Morawski *MOCCA Survey Database I. BHs in star clusters* (Proceedings of the 15th Marcel Grossmann Meeting in Rome (2018). [\[ADS Link\]](#)
7. M. Szkudlarek, D. Gondek-Rosińska, **A. Askar**, T. Bulik, M. Giersz: *Black Hole Binaries from Globular Clusters as Sources of Gravitational Waves* (52nd Rencontres de Moriond on Gravitation (Moriond Gravitation 2017). [\[INSPIRE Link\]](#)
8. M. Giersz, N. Leigh, A. Hypki, **A. Askar**, N. Lützgendorf: *Formation mechanisms of IMBH in globular clusters* (MmSAI v.87, p.555 2016). [\[ADS Link\]](#)
9. D. Belloni, M. Giersz, **A. Askar**, Hypki: *Cataclysmic variables in globular clusters . First results on the analysis of the MOCCA simulations database* (MmSAI v.87, p.551 2016). [\[ADS Link\]](#)
10. **A. Askar**, M. Giersz, W. Pych, A. Olech, A. Hypki: *MOCCA code for star cluster simulation: comparison with optical observations using COCOA* (IAU Symposium, Volume 312, pp. 262-263 2016). [\[ADS Link\]](#)
11. M. Giersz, N. Leigh, M. Marks, A. Hypki, **A. Askar**: *Monte Carlo modeling of globular star clusters: many primordial binaries and IMBH formation* (IAU Symposium, Volume 312, pp. 213-222 2016). [\[ADS Link\]](#)

## Selected Talks/Presentations at International Conferences & Institutes

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- Talk on “Formation of supermassive black hole in galactic nuclei: LISA binaries & intermediate-mass ratio inspirals” at MODEST-24: Exploring Dense Stellar Systems Across Cosmic Time, Warsaw, Poland (August 2024)
- Invited Seminar on “Formation & growth of supermassive black holes: intermediate-mass black holes delivered in stellar clusters & intermediate-mass ratio inspirals” at SISSA (International School for Advanced Studies), Trieste Italy (May 2024)
- Talk on “Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered via infalling stellar clusters” at MODEST-23: Star Clusters in the Post-Pandemic Era in Northwestern University, Evanston, IL, USA (August/September 2023)
- Invited Review Talk on “Formation and growth of nuclear star clusters and massive black holes: challenges and lessons from simulations” at European Astronomical Society (EAS) Annual Meeting (EAS 2023) in Krakow, Poland (July 2023)
- Talk on “GW190521 and intermediate-mass black holes in star clusters: formation pathways and open questions” at Niels Bohr International Academy (NBIA) Workshop on Black Hole Dynamics: From Gaseous Environments to Empty Space in Copenhagen, Denmark (May/June 2022)
- Invited Review Talk on “Dynamical formation of GW190521 in stellar clusters” at American Physical Society (APS) April Meeting in New York City, USA (April 2022)
- Invited Seminar on “Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered in stellar clusters” at Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences in Toruń, Poland (Feb 2022)
- Talk on “Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered in stellar clusters” at European Astronomical Society (EAS) Annual Meeting (Leiden, The Netherlands/Virtual



Meeting 2021)

- Invited Seminar on *“Formation and growth of supermassive black holes in galactic nuclei: intermediate-mass black holes delivered in stellar clusters”* at International Teeminar, Organized by ARI Heidelberg/Beijing (2021)
- Talk on *“Formation and growth of supermassive black holes in galactic nuclei: LISA binaries & intermediate-mass ratio inspirals”* at 3<sup>rd</sup> LISA Astrophysics Working Group Meeting (Zurich, Switzerland/Virtual Meeting 2021)
- Invited Seminar Talk on *“Black Hole Dynamics in Star Clusters: Evolution and Growth from Stellar to Supermassive Scales”* at the CENTRA - Center for Astrophysics and Gravitation (Lisbon, Portugal, 2021)
- Talk on *“Formation and Growth of Supermassive Black Holes in Galactic Nuclei: Dynamics of Triple Intermediate-mass Black Holes Delivered in Stellar Clusters”* at the Triple Evolution and Dynamics 3 (TRENDY 3 - Virtual Meeting 2021)
- Invited Seminar on *“Formation of gravitational wave sources in star clusters: From stellar to intermediate-mass black holes”* at University of Birmingham (Birmingham, United Kingdom 2020).
- Invited Talk on *“Dynamical formation of gravitational wave sources”* at XIX Serbian Astronomical Conference (Belgrade, Serbia 2020).
- Talk on *“Formation of supermassive black holes in galactic nuclei: delivering seed intermediate-mass black holes in stellar clusters”* at Galaxy Coffee, Max Planck Institute for Astronomy, MPIA (Heidelberg, Germany 2020).
- Talk on *“Formation of intermediate-mass black holes in dense stellar clusters”* at the 13th International LISA Symposium (Virtual Meeting 2020)
- Invited Review Talk on *“Dynamical Formation of Binary Black Holes in Dense Stellar Environments”* at European Astronomical Society (EAS) Annual Meeting 2020, Symposium 5: *What have we learned from the observed population of gravitational wave sources?* (Leiden, The Netherlands/Virtual Meeting 2020)
- Talk on *“Supermassive Black Hole Formation in Galactic Nuclei: The Role of Intermediate-mass Black Holes”* at Compact Objects For All Meeting at Lund Observatory, Department of Astronomy and Theoretical Physics, Lund University (Lund, Sweden 2020)
- Invited Talk on *“Gravitational Wave Sources Originating in Globular Clusters”* at DKGWEM-2020: Gravitational Wave Science in Denmark, Niels Bohr Institute, Copenhagen University (Copenhagen, Denmark 2020)
- Talk on *“Stellar Mass Black Holes in Globular Clusters: Dynamical Consequences and Observational Signatures”* at Galaxy Coffee, Max Planck Institute for Astronomy, MPIA (Heidelberg, Germany 2019).
- Invited Talk on *“Dynamically Driven Mergers of Black Holes in Dense Stellar Environments”* at Astrophysics with Gravitational Wave Detections Workshop (Warsaw, Poland 2019).
- Talk on *“Why Black Holes Matter in Globular Clusters: Dynamical Consequences and Observational Signatures”* at IAUS 351: Star Clusters: from the Milky Way to the Early Universe and MODEST 19 (Bologna, Italy 2019).
- Talk on *“How black holes can influence the evolution of globular clusters”* at the MWStreams 2018 conference on *“Survival of Dense Star Clusters in the Milky Way System”* (Heidelberg, Germany 2018)
- Invited Talk on *“Black Hole Populations in Galactic Globular Clusters”* at the SFB 881 International Workshop on Star *“Clusters around the Milky Way and in the Local Group”* (Heidelberg, Germany 2018)
- Invited to attended meeting of the *“Evolution of Rich Stellar Populations & Black Hole Binaries”* International Space Science Institute (ISSI) Team as a core participant and presented a talk on *“Black Hole Subsystems in Galactic Globular Clusters”* at the ISSI (Bern, Switzerland 2018).
- Talk on *“Black Hole Subsystems in Galactic Globular Clusters”* at MODEST 18 (Santorini, Greece 2018).
- Invited Seminar Talk on *“Investigating Black Hole Populations in Globular Clusters with MOCCA Code for Star Cluster Simulations”* at Galileo Galilei Department of Physics and Astronomy, University of Padova/INAF-Astronomical Observatory of Padova (Padova, Italy 2018).
- Invited Seminar Talk on *“Investigating Black Hole Populations in Globular Clusters with MOCCA Code for Star Cluster Simulations”* at Eötvös Loránd University (Budapest, Hungary 2018).
- Talk on *“MOCCA-Survey Database I: Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters”* at Numerical Scattering Workshop, Center for Computational Astrophysics, Flatiron Institute, (New York City, USA 2017).
- Talk on *“Gravitational Waves and High Energy Sources Originating From Globular Clusters”* at MODEST 17 (Prague, Czech Republic 2017).
- Invited Seminar Talk on *“MOCCA-Survey Database I: Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters”* at Lund Observatory Seminar (Lund, Sweden 2017).
- Seminar Talk on *“MOCCA-Survey Database I: Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters”* at Nicolaus Copernicus Center Wednesday Colloquium (Warsaw, Poland 2017).
- Talk on *“Coalescing Binary Black Holes Originating from Globular Clusters”* at Heraeus-Seminar 61: Stellar Aggregates (Bad Honnef, Germany 2016).
- Invited Seminar Talk on *“MOCCA-Survey Database I: Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters”* at KIAA/Peking University Lunch Talk (Beijing, China 2016).

- Invited Talk on *"Merging Binary Black Holes Originating from Globular Clusters"* at Astro-GR 2016 Meeting (Benasque, Spain 2016).
- Presented poster on *"Simulating Observations of MOCCA Star Cluster Simulations with COCOA"* at EES 2015 School on Stellar Clusters (Banyuls sur Mer, France 2015).
- Talk on *"Simulating Observations of MOCCA Star Cluster Simulations with COCOA"* at MODEST 15 (Concepcion, Chile 2015).
- Poster presentation, *"MOCCA Code for Star Cluster Simulations: Comparison with Optical Observations using COCOA"* at International Conference of Young Astronomers (Toruń, Poland 2014).
- Talk on *"X-ray Bursts"* at the 5th Serbian Astronomical Student Workshop hosted by University of Belgrade and University of Novi-Sad (Belgrade, Serbia 2011).

## Supervision, Mentoring & Teaching Activities

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- Supervisor for summer student project of Sohaib Ali (currently a masters student in Physics & Astronomy at Nicolaus Copernicus University in Toruń, Poland) on *'Investigating IMBH Growth and Observational Properties of Star Clusters Hosting IMBHs'* from July 2024 to October 2024.
- Designed and co-taught (with Mirek Giersz) a PhD level 3 ECTS course with 13 taught lectures and final assessment exercise on "Star Cluster Dynamics and Evolution" for GeoPlanet Doctoral School, Poland (Spring 2024); [\[Link to course website and lecture slides\]](#)
- Gave a 2 hour lecture on "Black holes in stellar clusters" in the 'ASTM12 - High Energy Astrophysics' masters course at Lund Observatory (Spring 2023)
- Gave a two lecture on "Computational Gravitational Dynamics: Simulating the Evolution of Globular Clusters" in the 'ASTM22 - Computational Astrophysics' masters course at Lund Observatory (Spring 2023).
- Supervised high school project of Viktor Wellander (Thorén Business School, Örebro, Sweden) on "Determining the Mass of the Supermassive Black Hole in our Galaxy" (Fall 2022).
- Prepared a 30 minute video lecture on "Introduction to Globular Clusters" for the 'Galactic Dynamics VT22' PhD course at Lund Observatory (Spring 2022) and led a 2-hour follow up class on the same topic.
- Gave a 2 hour lecture on "Black holes in stellar clusters" in the 'ASTM12 - High Energy Astrophysics' masters course at Lund Observatory (Spring 2021) and did a 2-hour follow up class with group exercises and discussion.
- Led lecture on "Astrophysical Origin of Gravitational Wave Sources" for the 'Topics on Theoretical Astrophysics' PhD course at Lund Observatory (Spring 2021)
- Master thesis supervisor of Markus Strickert (Master student at Lund University 2021-2022, currently a PhD student at Leiden University, The Netherlands); [\[Thesis Link\]](#)
- Master thesis supervisor of Lucas Hellström (Master student at Lund University 2019-2020, currently a PhD student at CAMK, Warsaw, Poland); [\[Thesis Link\]](#)
- Bachelor thesis supervisor of Matilda Skantz at Lund University (2023); [\[Thesis Link\]](#)
- Bachelor thesis supervisor of Annie Csomer at Lund University (2022); [\[Thesis Link\]](#)
- Completed course on "Learning and teaching in higher education - theory and practice" for pedagogical training (Lund University, Spring 2020)
- Gave a 2 hour lecture on "Neutron stars, pulsars and compact binaries" for the 'ASTM12 - High Energy Astrophysics' masters course at Lund Observatory (Spring 2019)
- Co-supervised several summer student projects at Nicolaus Copernicus Astronomical Center from 2015 to 2017 (Poland):
  - Jakub Morawski (2017 Bachelor Student, Warsaw Observatory)
  - Piotr Kołodziejcki (2016 Bachelor Student, Warsaw Observatory),
  - Jakub Klencki (2016 Master Student, Warsaw Observatory),
  - Piotr Adamczyk and
  - Magdalena Szponar (2015 Bachelor Students Warsaw Observatory)
- Co-supervised and assisted with Masters thesis project of Riko Schadow (Ludwig Maximilian University of Munich, 2015) and research project by Arthur Kuehlwein (Heidelberg University, 2015)

## Prizes & Awards

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- POLONEZ BIS fellowship awarded by the European Commission and the Polish National Science Centre (NCN) under the Marie Skłodowska-Curie COFUND action (2023 to 2025)
- **Declined:** Research fellowship from the Swedish National Space Agency (Rymdstyrelsen) (2023 to 2026)
- Awarded Carl Tryggers Postdoctoral Fellowship (2018 to 2020)
- PhD Scholarship in Stellar Dynamics, National Science Center, Poland (2013 to 2017)
- Preludium Grant for PhD Students awarded by the Polish National Science Center (NCN) in 2016
- Award for Best Poster at International Conference of Young Astronomers (Toruń, Poland 2014)

- Erasmus Mundus (European Commission) Scholarship for Joint Masters Degree in Astrophysics and Astronomy (2010 to 2012) Total Award: €15,000
- Excellence Scholarship for Undergraduate Studies at University College Utrecht (2006-2009)  
Total Award: ~ € 21,000
- Merit Scholarship for A Levels at University College Lahore (2004-2006)
- Award for Excellence in Computing, University College Lahore (2005)
- Award for Academic Excellence, Bloomfield Hall School (2001)

## Funding & Grants

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- Principal Investigator (PI) of the POLONEZ BIS 1 grant co-funded by the European Commission and the Polish National Science Centre (NCN) under the Marie Skłodowska-Curie COFUND grant (Sept 2023 to Aug 2025), Project Title: *Growth of Black Holes in Stellar clusters*; Total Funding: ~€214,000
- **Declined:** Principal Investigator (PI) of the Career Grant (2022-C) by the Swedish National Space Agency (Rymdstyrelsen) (2023 to 2026), Project Title: *Growth of black holes in star clusters: Dynamical formation of gravitational wave sources and high-energy transients*; Total Funding: ~€303,000
- Co-Investigator of the OPUS grant awarded by the Polish National Science Centre (NCN) (2022 to 2025), Project Title: *Compact Objects in Star Clusters as a Laboratory for Multi-Messenger and High Energy Astrophysics* ; Total Funding: ~€324,000
- Principal Investigator (PI) of the Fysiografen grant awarded by the Royal Physiographic Society of Lund (2019 to 2020); Title: *Evolution of Binaries containing Massive Stars* ; Total Funding: ~€13,450
- Carl Tryggers Fellowship for postdoctoral research awarded by the Carl Tryggers Foundation for Scientific Research in Sweden (2018 to 2020) Total Funding: ~€52,500
- PI of the Preludium grant for PhD students awarded by the Polish National Science Center (2016 to 2018)  
Title: *Black Hole Binary Zoo in Globular Clusters* Total Funding: ~€15,750
- PI of the Nicolaus Copernicus Astronomical Center Grant for Young Researchers (2015 to 2017)  
Title: *Simulating Mock Observations of Star Cluster Simulations* Total Funding: ~€3000

## Professional Memberships, Service Work and Meeting Organization

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- Chair of the scientific organizing committee and member of the local organizing committee for “MODEST-24: Exploring Dense Stellar Systems Across Cosmic Time” conference hosted by the Nicolaus Copernicus Astronomical Center in Warsaw, Poland (19-23 August 2024): [\[Conference Website\]](#)
- Member of the European Astronomical Society (EAS) since 2023
- Junior Member of the International Astronomical Union (IAU) since 2019: [\[IAU Page\]](#)
- Member of the LISA (Laser Interferometer Space Antenna) consortium and its astrophysics working group since 2018
- Expert reviewer for the following journals: Monthly Notices of Royal Astronomical Society (MNRAS), The Astrophysical Journal (ApJ), ApJ Letters, Astronomy & Astrophysics (A&A), A&A Letters, Acta Astronomica
- Organizer and chair for the ‘Stellar Dynamics and Evolution’ group meetings at Lund Observatory since 2021
- Examination committee member for master and bachelor student exams at Lund Observatory (2019, 2020, 2021)
- Scientific equipment procurement coordinator for Fysiografen grants at Lund Observatory (Fall 2022) • Member of the local and scientific organizing committees for ELTs for All meeting at Lund Observatory in Sweden (11 to 12 February, 2019)
- Expert reviewer for grant proposals submitted to National Fund for Scientific and Technological Development (FONDECYT) of Chile (2019)
- Member of LOC for Spotkanie Młodych (Young Astronomers Meeting) at Nicolaus Copernicus Astronomical Center (2014 and 2016)

## Outreach Activities: Popular Talks and Public Lectures

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- “*Growing Black Holes in Star Clusters*” at the International Conference for Young Astronomers hosted by the Nicolaus Copernicus Astronomical Center in Warsaw, Poland (2024).
- “*Merging Black Holes in Dense Star Clusters*” at Space Research School for high school students organized by Astronomisk Ungdom and Lund Observatory, Sweden (2023).
- Presented public talk (for high school students) on “*Merging Black Holes in Star Clusters*” at NMT Dagarna at Lund Observatory, Sweden (2023).
- Public talk on “*Merging Black Holes in Star Clusters*” at Kulturnatten (Culture Night) 2022 at Lund Observatory,

Sweden (2022).

- Invited popular talk on “*Merging Black Holes in Star Clusters*” at Gastronomilägret summer camp organized by Astronomisk Ungdom, Sweden (2022).
- Presented public talk (for high school students) on “*Merging Black Holes in Star Clusters*” at NMT Dagarna at Lund Observatory, Sweden (2022).
- Presented public talk on “*Simulating Star Clusters: Dynamical Evolution to Merging Black Holes*” at Kulturnatten (Culture Night) 2019 at Lund Observatory, Sweden (2019).
- Presented public talk on “*Cosmic Explosions: From Supernovae to Colliding Black Holes*” at Knut Lundmark-dagarna 2019 at Lund Observatory, Sweden (2019).
- Presented public talk (for high school students) on “*Merging Black Holes in Star Clusters: The New Era of Gravitational Wave Astrophysics*” at NMT Dagarna at Lund Observatory, Sweden (2019).
- Presented public talk on “*Astrophysics of Star Clusters*” at Monthly Meeting of Lahore Astronomical Society (LAST) hosted at Zeds Astronomical Observatory, Lahore, Pakistan (2019).
- Invited Popular Talk on “*Binary Black Holes and Intermediate Mass Black Holes in Globular Clusters*” at Koło Naukowe Astronomów (Student’s Astronomy Circle), University of Warsaw Observatory, Poland (2017).
- Presented popular talks on ‘Evolution of Star Clusters’ at Spotkanie Młodych (Young Astronomers Meeting), Nicolaus Copernicus Astronomical Center (2014 and 2016).

## Scientific Programming and Open Source Tools

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Member of the development team of the [MOCCA code](#) for star cluster simulations since 2013.

### Open Source Development (2016–Present):

- Led the development of the *COCOA* code (written in *Python* & *C*): [\[Github Page\]](#) & [\[ASCL Entry\]](#)
- Contributed by fixing bugs and improving *NBODY6++GPU* code (GPU accelerated direct *N*-body code for collisional stellar dynamics): [\[Github Page\]](#)
- Co-developed an interactive *Jupyter* notebook that uses a supervised machine learning algorithm to use observational properties of a star cluster to predict how many black holes it may contain: [\[Github Page\]](#)

## Skills & Miscellaneous

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**Computer Languages:** Proficient in *Python*, *Fortran*, *Shell Scripting*,  $\text{\LaTeX}$ . Fairly decent with *C* and basic experience with *Apache Pig* and *HTML*.

**Data Visualization:** Proficient with *gnuplot*, *matplotlib* (and other Python visualization libraries e.g., *seaborn*). Fairly decent with *TikZ*, *matcha*

**Software:** Proficient with *Mathematica*, *TOPCAT* and experience with *MATLAB*. Very experienced in using popular presentation, word processing and spreadsheet programs. Experienced in using *Git* for tracking software updates.

**Graphic Design/Vector Graphics:** Fairly decent with *Inkscape* and *GIMP* (Vector Graphics Editors)

**Languages:** English (Fluent), Urdu (Native), Polish (Beginner Level), Dutch (Beginner Level), Punjabi (Intermediate Level)